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ON THE GEOLOGY OF QUEBEC AND ENVIRONS

BY

HENRY M. AMI, OF THE GEOLOGICAL SURVEY OF CANADA

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ON THE GEOLOGY OF QUEBEC AND ENVIRONS.

BY HENRY M. AMI, OF THE GEOLOGICAL SURVEY OF CANADA.

(Read before the Society December 31, 1890.)

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INTRODUCTION.

The purpose of this paper is to give a brief résumé of the conclusions arrived at by the writer respecting the different faunas included in the different terrans in and about Quebec city. These conclusions are based upon an examination of several recent collections of fossils (made by Mr. Weston in 1877, 1887 and 1890; by Dr. Ellis, l'Abbé Laflamme and Mr. Giroux in 1888; by Mr. St. Cyr in 1888, 1889 and 1890; and by the writer in 1886, 1887, 1888 and 1890) and upon an examination of the extensive collections and material which Sir William Logan and Mr. Billings made use of in describing the geology and paleontology of this interesting though complicated region.

The localities from which the collections above mentioned were made are all included within a radius of about fifteen miles from Quebec city as a center. The following localities are included:

I. *Quebec City (northern side of the St. Lawrence).*

- a. Between the drill shed and Grande allée.
- b. 100 yards south of Montcalm market.
- c. St. John street, numbers 71 and 73.
- d. Côte d'Abraham.
- e. Côte de la Negresse.
- f. Côte Sauvageau.
- g. The coal fields.

II. *Lévis (southern side of the St. Lawrence).*

- a. I. C. R. cutting.
- b. Road from Lévis to St. Joseph.
- c. 150 yards west of b.
- d. Cliff south of Carrière and Lainy's foundry.
- e. City hall, Lévis.
- f. Near toll-gate, South Quebec.
- g. Between toll-gate and Victoria hotel, South Quebec.

III. *Montmorency Falls (northern shore).*

- a. Above the falls; Trenton limestone, etc.; left bank.
- b. Above and close to the falls; right bank.
- c. Ravine below the falls; left bank (limestones).
- d. Ravine below the falls; left bank (shales).
- e. Gorge between the steps and mouth of river.
- f. Mouth of the river; East point.

IV. *Beauport (northern shore); Parent's quarries.*

- a. In shales.
- b. In limestones.

V. *Charlesbourg (north of Quebec City).*

- a. Templeman's quarry.
- b. 50 yards south of Charlesbourg church.
- c. 1 mile west of village.

VI. *Lorette (falls of St. Charles river).*

- a. In the upper thinly bedded limestones.
- b. In the lower heavier bedded limestones.

VII. *Island of Orleans (east of Quebec city).*

- a. False point (limestones and shales).
- b. Near Bel-Air hotel (shales).

VIII. *St. Nicholas (southern shore).*

Two miles above the village.

IX. *Pointe-aux-Trembles, Quebec.*

- a. In bituminous shales.
- b. In limestone beds.

The fossil remains obtained from these localities have been identified in so far as the mode of preservation and condition of the specimens permit. The collections made by Mr. Weston in 1890 have not yet been examined as critically as might be desired, but they only serve to intensify the results obtained in the examination of previously obtained material.

The researches of Sir William Logan, Mr. Billings, Dr. Sterry Hunt, Dr. Selwyn, Sir William Dawson, Professor James Hall, Professor Emmons, Professor Walcott, Professor Marcou, Dr. Ells, Professor Lapworth, and many others, on the geology of Quebec and its environs, have made that region classic ground to the student of North American geology. The famous Quebec group controversy, as well as its closely related friends, the Taconic question in geology and the Lorraine-Hudson River problem, are all involved in the geologic history of Quebec. Much diversity of opinion has existed as to the exact geological position of some of the terranes at and about Quebec city, as also along the whole line of the great Appalachian or St. Lawrence-Champlain fault; and this is not at all astonishing, seeing that

profound dislocations exist, intricate foldings of strata occur, and several terranes are met along a comparatively short section, faulted and folded together in anything but a simple manner, which require exceedingly detailed and careful examination before satisfactory conclusions are arrived at.

The rocks forming the Citadel hill or promontory of Quebec (Cape Diamond) have been assigned to different positions in the geological scale by different writers at different times. An interesting review of their views is given in Dr. Ellis' last report to Dr. Selwyn (1888), and published by the Geological Survey of Canada, which extends from Dr. Bigsby's paper (1827), down to Professor Lapworth's report, etc., published in the "Transactions of the Royal Society of Canada" (1887). These Quebec rocks have been referred by Logan to the age of the Quebec group (Lévis division), by others to "Utica-Trenton," "Trenton-Utica," "Utica-Hudson" and "Lorraine" age, while still others, and the majority at present, regard them as newer than the Trenton limestone, *i. e.*, as of "Hudson River" age, or newer than the Utica terrane, and forming part and parcel of an extensive series of sedimentary strata classed under the term "Hudson terrane."

I shall not attempt to enter into a discussion of the views held by geologists, both in Canada and in the United States, in this matter. Such a task I had to undertake and accomplish for myself previous to this, and I will not burden the Society with it on this occasion. I wish merely to call attention to a number of plain facts obtained in the field and from an examination of extensive collections of fossils. When series of strata are found lying between dislocations and faults, presenting no clear stratigraphical relations to the adjoining strata, the lithological character of the beds along with paleontological evidence must necessarily come in to assist us in ascertaining the definite horizon to which they belong. With the aid of these criteria some interesting notes have been obtained.

THE TERRANES EXPOSED ABOUT QUEBEC.

The rocks about Quebec city and within the scope of this paper (leaving out of consideration the "glacial" and "marine" clays of post-Tertiary times) include the following series of well-marked natural divisions:

I.	II.	III.
<i>Archean.</i> { Laurentian or Archean.	<i>Quebec.</i> { Quebec massif. Lévis. Sillery.	<i>Trenton.</i> { Lorraine. Utica. Trenton.

These seven terranes are clearly seen in a section from Lorette or Charlebourg southward through the city of Quebec and across the St. Lawrence

at Point Lévis. They occur in the following geographical succession, beginning toward the north :

1. Laurentian or Archean.
2. Trenton.
3. Utica.
4. Lorraine.
5. Quebec (massif).
6. Lévis.
7. Sillery.

Between the Laurentian and Trenton terranes, numbers 1 and 2, there occur an unconformity and an overlap, as seen at Lorette and Charlesbourg. There we find the Trenton directly overlain by the Utica terrane, which is in turn overlain by the Lorraine shales—in the district lying between Lorette and Côte Sauvageau, Quebec city,—these three affording a regular ascending series of sedimentary strata, whose characters are readily seen and recognized throughout the region in question. Then follow toward the south the calcareo-bituminous rocks, indurated shales, compact limestones, and conglomerate bands which form the Quebec city massif, bounded on the north by a thrust fault which brings them against the disturbed and twisted edges of the Lorraine shales, and bounded on the south by the St. Lawrence river and another fault which brings them in contact with the Sillery rocks toward the southwest and with the Lévis toward the southeast. On the southern side of the St. Lawrence we find next the Lévis shales, limestones and conglomerate bands coming in over the Sillery shales (red, green and gray) and sandstones, with which they are folded and faulted many times. Taking these terranes in their natural and present geographical order as above, they may be described in detail.

DESCRIPTION OF THE TERRANES.

The Laurentian or Archean.—Granites and gneisses, hornblendic and micaceous rocks of usual occurrence in the lowest divisions of this system of rocks, are met with at Montmorency falls underlying the Trenton limestone; at Lorette falls, below the lowest beds of Trenton limestone there exposed; and also north of Charlesbourg village and quarries, presenting a series of more or less elevated rounded bosses which, toward the west, north and east, develop into hills and mountains of greater magnitude, whose southern limit in the Quebec city region and vicinity seems to mark the line of an ancient escarpment, which predicates the existence of an extensive dislocation in the Archean crust and accounts for the peculiar absence of that series south of this line. Mr. A. P. Low, of the Canadian Geological Survey, is now engaged in mapping the geological features of the Archean area north of

Quebec, and Dr. Selwyn has placed an interesting collection of these rocks, made by Mr. Weston at Montmorency falls, in the hands of Mr. Ferrier, who will discuss their lithological and petrographical characters in the near future.

The Trenton: Lorette.—At Lorette falls, on St. Charles river, the Trenton limestones are seen to rest unconformably over the Laurentian. They consist at the top of thinly bedded, impure limestones, holding a number of characteristic fossils, including—

<i>Strophomena alternata</i> ;	<i>Bellerophon bilobatus</i> ;
<i>Leptaena sericea</i> ;	<i>Trinucleus concentricus</i> ;
<i>Orthis testudinaria</i> ;	<i>Illænus</i> , sp. und.

There are some fifty feet of strata exposed in the whole escarpment (which faces the north) here along the line of contact at the falls, the lowest of which are rather heavily bedded and consist of light gray semi-crystalline limestones, abounding in fossil remains characteristic of the Trenton, the presence of *Lituites undatus*, Emmons, at the base indicating proximity to the Black River formation. The following species were obtained in the lower beds of the exposure:

<i>Pachydictya acuta</i> ;	<i>Ambonychia bellistriata</i> (?) ;
<i>Batostoma ottawaëense</i> ;	<i>Pterinea trentonensis</i> ;
<i>Prasopora lycoperdon</i> ;	<i>Lituites undatus</i> ;
<i>Discina pelopea</i> ;	<i>Endoceras proteiforme</i> ;
<i>Lingula philomela</i> ;	<i>Aparchites mundulus</i> ;
<i>Strophomena alternata</i> ;	<i>Primitia whiteavesii</i> ;
<i>Leptaena sericea</i> ;	<i>Ischilina amii</i> ;
<i>Orthis testudinaria</i> ;	<i>Primitia mundula</i> ;
“ sp. und.;	<i>Beyrichia</i> , sp. und.;
“ sp. nov. (?) ;	<i>Ceraurus pleurexanthemus</i> ;
<i>Anastrophia hemiplicata</i> ;	<i>Calymene senaria</i> ;
“ var. (?) ;	<i>Enerinurus vigilans</i> ;
<i>Conularia trentonensis</i> ;	<i>Dalmanites callicephalus</i> ;
<i>Theca</i> , sp. nov.;	<i>Trinucleus concentricus</i> ;
<i>Bellerophon bilobatus</i> ;	<i>Asaphus platycephalus</i> ;
<i>Bucania punctiferous</i> ;	<i>Lichas</i> , sp. und.;
<i>Ctenodonta dubia</i> ;	<i>Illænus milleri</i> .

Charlesbourg.—At Charlesbourg the Trenton terrane may be seen to advantage some four hundred yards north of the village, and also at Templeman's quarry, a few paces east of the road. Here the strata are horizontal, while at Lorette they are considerably inclined, the dip there increasing from four or five degrees to nearly thirty in the vicinity. The rock at Templeman's quarry is rather pure and crystalline, takes a good dressing, and the

beds vary in thickness from four or five inches up to a foot, and contain several characteristic species as follows:

<i>Pachydietya acuta</i> ;	<i>Leptæna sericea</i> ;
<i>Ptilodietya faleiformis</i> ;	<i>Orthis testudinaria</i> ;
<i>Prasopora lycoperdon</i> ;	<i>Murchisonia gracilis</i> ;
<i>Crania</i> , sp. und.;	<i>Endoceras proteiforme</i> ;
<i>Schizocrania</i> , or <i>Discina</i> ;	<i>Illænus</i> , sp. und.;
<i>Lingula riciniiformis</i> ;	<i>Calymene senaria</i> ;
<i>Strophomena alternata</i> ;	<i>Dalmanites callicephalus</i> .

Beauport.—Proceeding farther eastward along the line of outcrop, the Trenton occurs at Beauport and at Parent's quarries, where the limestones are overlain by the black bituminous shales of the Utica. The following species of fossils were obtained by Mr. St. Cyr, curator of the museum of the Department of Public Instruction, Quebec:

<i>Amplexopora discoidea</i> ;	<i>Conularia trentonensis</i> ;
<i>Prasopora lycoperdon</i> ;	<i>Orthoceras</i> , sp. nov.;
<i>Lingula obtusa</i> ;	<i>Asaphus platycephalus</i> ;
<i>Strophomena deltoidea</i> ;	<i>Calymene senaria</i> ;
<i>Anastrophia hemiplicata</i> ;	<i>Ceraurus pleurexanthemus</i> .

Montmorency.—The Montmorency river at and above the falls, before plunging its waters headlong down the steep height of 251 feet, flows over Laurentian or Archean rocks. It has cut its way through the thinly bedded impure limestones, which are often interstratified with very thin beds of fissile shale, such as is also said to occur in the lowest beds of the quarry at Charlesbourg. Along each bank on this river the Trenton is well developed and carries with it a large assemblage of fossils, among which *Trinucleus concentricus*, *Bellerophon bilobatus* and *Solenopora compacta* may be said to occur in great abundance. Along the left bank of the river and above the bridge the following species were obtained by Dr. Ellis and the writer:

<i>Pachydietya acuta</i> ;	<i>Bucania punctifrons</i> ;
<i>Prasopora lycoperdon</i> ;	<i>Murchisonia gracilis</i> ;
<i>Solenopora compacta</i> ;	" <i>perangulata</i> ;
<i>Lingula curta</i> (?);	<i>Orthoceras</i> , sp. nov.;
<i>Strophomena alternata</i> ;	" <i>laqueatum</i> (?);
<i>Leptæna sericea</i> ;	<i>Vanuxemia</i> , sp. und.;
<i>Orthis testudinaria</i> ;	<i>Harpes</i> , sp. und.;
" <i>pectinella</i> ;	<i>Encrinurus vigilans</i> (?);
<i>Anazyga recurvirostra</i> ;	<i>Asaphus platycephalus</i> ;
<i>Zygospira</i> (?) <i>modesta</i> ;	<i>Ceraurus pleurexanthemus</i> ;
<i>Conularia trentonensis</i> ;	<i>Illænus milleri</i> .
<i>Bellerophon bilobatus</i> ;	

In this district the Trenton is again seen to occur at the foot of the falls up the brook and ravine at the north end of the gorge, where the limestones are made to abut at a high angle against the Archean escarpment by a down-throw fault. The limestones are light-gray colored, impure and bituminous. There are only a few feet of apparently upper Trenton beds seen at this point between the cliff and the disturbed Utica beds alongside of and overlying them.* The following is a list of the species of fossils obtained from the limestones up the ravine and along the brook:

<i>Hyalostelia</i> , sp. und.;	<i>Orthis testudinaria</i> ;
<i>Glyptocrinus</i> , or <i>Glyptocystites</i> ,	<i>Primitia</i> , sp. und.;
sp. und.;	<i>Illenus</i> , sp. und.;
<i>Leptæna sericea</i> ;	<i>Calymene senaria</i> .
<i>Strophomena</i> , sp. und.;	

On the right bank of the river and close to the falls on Mr. Hall's property (near his residence) the following Trenton species were obtained:

Crinoidal fragments;	<i>Zygospira modesta</i> ;
<i>Dictyophyton</i> (?), sp. und.;	<i>Strophomena alternata</i> ;
<i>Lingula</i> , sp. und.;	<i>Conularia</i> , sp. nov.;
<i>Orthis</i> probably <i>testudinaria</i> ;	<i>Trinucleus concentricus</i> .

Pointe-aux-Trembles.—Among the remaining localities where the Trenton terrane has been met we have Pointe-aux-Trembles, near the mouth of the Jacques Cartier river, where the Utica shales also occur, overlying the limestones. From these the following species of characteristic Trenton fossils were obtained:

<i>Heterocrinus canadensis</i> ;	<i>Leptæna sericea</i> ;
<i>Monticulipora</i> , sp. und.;	<i>Dalmanites callicephalus</i> ;
<i>Strophomena alternata</i> ;	<i>Calymene senaria</i> ;
" <i>deltoidea</i> ;	<i>Asaphus platycephalus</i> ;
<i>Orthis testudinaria</i> ;	<i>Ceraurus pleurexanthemus</i> .
<i>Anastrophia hemiplicata</i> ;	

The above lists of species from Lorette, Charlesbourg, Beauport, Montmorency and Pointe-aux-Trembles are sufficiently characteristic to leave no question whatever as to the age of the rocks from which they were obtained.

The Utica: Distribution.—The Utica shales are observed at several places about Quebec city, and are readily recognized by the fauna which they contain. For the most part the shales consist of brown or buff weathering and black bituminous calcareo-argillaceous materials in a finely divided state and very brittle or friable. At Montmorency falls, Beauport and Charlesbourg

*The quartzose limestone or calcareous sandstones of Trenton age, underlying the Trenton and overlying the gneiss at Montmorency, are also of Trenton age, no Potsdam, Calceiferous, or Chazy being present.

a number of interesting collections were made by Dr. Ells, l'Abbé Laflamme, Mr. St. Cyr, Mr. Weston and the writer, and the following lists of species have been prepared therefrom.

Montmorency.—In the soft, brittle calcareo-argillaceous and bituminous shales which are much disturbed and faulted in a position overlying the Trenton limestones of the brook in the ravine at the northern end of the gorge of Montmorency falls were found the following species:

<i>Diplograptus</i> , sp. und.;	<i>Endoceras proteiforme</i> ;
<i>Climacograptus</i> , sp. und.;	<i>Serpulites dissolutus</i> ;
<i>Orthograptus quadrimucronatus</i> ;	<i>Triarthrus becki</i> .
<i>Leptobolus insignis</i> ;	

Between the steps leading from the top of the gorge on the eastern side to the foot of the falls and the lower point, the following species were collected by the writer:

<i>Orthograptus quadrimucronatus</i> (?);	<i>Climacograptus</i> , sp. und.;
<i>Reteograptus eucharis</i> ;	<i>Triarthrus becki</i> .

Beauport.—Leaving the Utica at the foot of the falls (much disturbed and faulted between the steps and the cliff at the northern end of the gorge) and the more evenly bedded and inclined strata south of the steps to the lower point, and proceeding westward to Beauport, the Utica is again seen at this point. Near the shore, l'Abbé Laflamme obtained a large slab of shale on which were seen a *Climacograptus*, sp. und., several examples of the typical *Leptobolus insignis*, Hall, and *Triarthrus becki*, Green.

At Parent's quarries, a little further northward, the Utica shales were examined by Mr. St. Cyr, and the following species obtained:

<i>Schizocrania filosa</i> ;	<i>Endoceras proteiforme</i> ;
<i>Leptaena sericea</i> ;	<i>Asaphus canadensis</i>
<i>Lyrodesma pulchellum</i> ;	(= <i>Asaphus latimarginatus</i>).

The above species are now in the museum of the Department of Public Instruction, Quebec.

Charlesbourg.—About fifty paces south of the Charlesbourg church the Utica is exposed along the main road. It dips at a considerable angle toward the south, varying in intensity from north to south from a few degrees to nearly fifty degrees. The rock here is a brownish-gray calcareous shale, from which the following species were obtained:

<i>Climacograptus</i> or <i>Diplograptus</i> ;	<i>Bellerophon bilobatus</i> ;
<i>Leptograptus</i> (?) <i>flaccidus</i> ;	<i>Primitia ulrichi</i> (?);
<i>Leptobolus insignis</i> ;	<i>Triarthrus becki</i> .
<i>Strophomena</i> , sp. und.;	

A larger collection of specimens from this locality would be interesting. With the exception of *Leptobolus insignis*, Hall, *Bellerophon bilobatus*, Sowerby, and *Triarthrus beeki*, Green, all very characteristic Utica species, the forms are not well preserved.

About a mile west of Charlesbourg church, on the road to Lorette, the black bituminous shales of the Utica again crop out in a small brook, and the following forms occur:

Climacograptus, sp. und.;
Orthograptus quadrimucronatus;
Leptobolus insignis.

L'Abbé Laflamme, of Laval university, who has devoted considerable attention to the geographical distribution of the different terranes in this district for the Canadian geological survey, collected a large slab of somewhat indurated black calcareous and bituminous shale on which were the following species:

Orthograptus quadrimucronatus;
Leptobolus insignis;
Triarthrus beeki.

Pointe-aux-Trembles.—In 1888, Dr. Ells obtained the following species of Utica fossils, overlying the Trenton limestones of Pointe-aux-Trembles:

Orthograptus quadrimucronatus;
Leptobolus insignis;
Triarthrus beeki.

These three forms are, as can be readily seen, typical and characteristic and generally abound in every collection of Utica specimens.

The Lorraine: General Character and Distribution.—The Lorraine shales form the fourth of the series of geological terranes occurring along the line of section from north to south, and consist for the most part of very thin, fissile and evenly bedded calcareo-argillaceous and arenaceous shales, weathering yellowish brown, measuring a thickness of 800 or 900 feet, and overlying the black bituminous shales of the Utica terrane conformably. They are extensively developed north of the city of Quebec, at Montmorency falls, at St. Nicholas, along the southern shore, and also farther eastward along the northern end of the Island of Orleans. These shales are not very fossiliferous in most of the exposures, but sufficient fossil evidence has been obtained to fix the position of the shales in the region where the thrust fault which occurs has disturbed the strata considerably. They are separated from the Quebec city massif by the thrust fault already indicated (which is evi-

dently the St. Lawrence and Champlain fault itself), and are also made to abut against the Sillery formation on the same ground.

St. Nicholas.—About two miles above the village of St. Nicholas, Dr. Ellis and the writer obtained the following species from the upturned and broken beds of this terrane:

<i>Orthograptus quadrimucronatus</i> ;	<i>Ambonychia radiata</i> ;
<i>Diplograptus</i> , sp. nov.;	<i>Orthodesma parallelum</i> ;
<i>Leptæna sericea</i> ;	<i>Modiolopsis</i> , sp. und.;
<i>Orthis testudinaria</i> ;	<i>Trinucleus</i> , sp. und.
<i>Zygospira headi</i> ;	

Côte Sauvageau.—At Côte Sauvageau these shales are also well exposed, and may be seen to advantage along the road leading to the tanneries. Occasionally there is met here, as at St. Nicholas and Montmorency, in the gorge, a band or two of hard, compact quartzite, with thin films of shale separating it from the softer and more fissile strata. These hard bands are well seen in the gorge at Montmorency. One of these bands at Côte Sauvageau showed the presence of *Anazyga recurvirostra*, Hall, and *Orthis testudinaria* in the thin film of shale overlying it, but no other forms were obtained here except very obscure and ill preserved fragments of graptolites, apparently diprionidæan.

Montmorency Falls.—On both sides of the gorge below the falls of Montmorency river the Lorraine shales are well developed and form a part of Sir William Logan's original section.* Here the strata are inclined at a high angle, averaging 45°, and are extremely soft, fissile and earthy; the harder bands, which are also lighter colored, standing out in relief. These shales are often stained purple and show evidence of disintegration from a once harder and more compact rock. None of the characteristic fossils of the Lorraine shales which abound at St. Nicholas were found here. *Orthograptus quadrimucronatus*, however, was found, and a careful examination of the strata would no doubt reveal other forms entombed in these strata.

The Quebec: The Quebec Massif.—Next in order comes the series of rocks forming Cape Diamond, the Citadel front and base, and the upper town proper in Quebec city. The rocks which constitute this series are varied and numerous.

At Côte d'Abraham they consist of hard, compact, black, bituminous, calcareous bands, which break with a conchoidal fracture and hold fragments of graptolites, associated with a band of what appears to be a hard and cherty conglomerate, carrying clear grains of quartz and holding a number of fossils, chiefly monticuliporidæ. At this locality the following

* Geology of Canada, 1863, pp. 198 79.

forms have been obtained (descriptions of which will, it is hoped, soon be published):

- Girvanella*, sp. und.;
Solenopora compacta, var. *minuta* (var. nov.);
Diplotrypa quebecensis (sp. nov.);
Monotrypa incerta (sp. nov.);
Prasopora lycoperdon, Vanuxem, var. *selwyni* (var. nov.);
Orthis, allied to *O. testudinaria*, Dalman;
Leptæna, like *L. sericea*;
Asaphus, sp. und.; an obscure form.

This peculiar association of forms occurring in such a series of strata will be noted later on.

Côte de la Nègresse.—Farther westward, at Côte de la Nègresse, the hard, compact and fine-grained calcareo-argillaceous and bituminous bands were seen, associated with bands of semi-crystalline and somewhat bituminous limestones, quite different in facies from the strata at Côte Sauvageau; and at the turn of the road up the hill along Richmond street two obscure fossils were obtained, one of which appears to be a *Camerella* or *Anastrophia*, the other a *Platystrophia* or other coarsely ribbed brachiopod. The strata here dip at an angle of 45° southward.

Montcalm Market.—Immediately south and again about one hundred yards southwest of Montcalm market, in the city of Quebec, we have a series of black bituminous and calcareous shales holding abundance of graptolites, brachiopods, ortracods and trilobites, with bands of thinly bedded limestones and an occasional hard, cherty, compact, quartz-bearing band, which resembles a conglomerate. The strike of the strata here is N. 45° E. (magnetic), and the dip about 70°, increasing to 78° in some instances. From the exposures north of St. Patrick street and between the roads leading from that street to the market the following fossils have been obtained:

<i>Diplograptus foliaceus</i> ;	Crinoidal fragments;
" <i>angustifolius</i> ;	<i>Lingula</i> , sp. nov. (no. 1);
" sp. und.;	" " (no. 2);
" <i>rugosus</i> ;	" " (no. 3);
" <i>mucronatus</i> ;	<i>Paternula</i> (?), sp. nov.
" <i>whitfieldi</i> ;	<i>Discina</i> , sp. nov. (no. 1);
<i>Climacograptus scalaris</i> ;	" " (no. 2);
" var.;	Gen. nov. et sp. nov.;
" sp. und.;	<i>Leptæna</i> , sp. nov.;
" <i>perexcavatus</i> ;	" allied to <i>L. sericea</i> ;
" sp. und.;	" allied to <i>L. quinquecostata</i> ;
" <i>bicornis</i> ;	<i>Strophomena</i> (?), or gen. nov. et sp. nov.;

<i>Dicellograptus sextans</i> ;	<i>Orthis</i> , sp. und.;
" <i>anceps</i> ;	<i>Stricklandinia</i> (?), sp. und.;
" <i>forchammeri</i> ;	<i>Obolella</i> , or closely related genus;
" <i>divaricatus</i> , var. <i>mof-</i>	<i>Euomphalus</i> , sp. nov., or <i>Ophileta</i> , sp.
<i>fatensis</i> , Carr.;	nov.;
" sp. und.;	<i>Primitia logani</i> ;
" sp. und.;	<i>Aparchites mundulus</i> ;
<i>Glossograptus</i> , sp. und.;	" sp. nov., or <i>Polycope</i> , sp. und.;
<i>Dendrograptus</i> , sp. und.;	<i>Agnostus</i> , sp. und.;
<i>Leptograptus</i> , sp. und. (cf. <i>L. per-</i>	<i>Aeglna rediviva</i> , Barr. (?);
<i>tenuis</i>);	<i>Bathyrurus</i> , sp. und.;
<i>Dicranograptus ramosus</i> ;	<i>Ampyx</i> , sp. und.;
" <i>nicholsoni</i> (?), Hopk.;	<i>Asaphus</i> , sp. und.;
" sp. nov.;	<i>Ilænus</i> , sp. und.;
<i>Corynoides calycularis</i> ;	<i>Trinucleus</i> (?), sp. und.;
<i>Dawsonia</i> , sp. und.;	<i>Dionide</i> (?), cf. <i>D. lapworthi</i> .

Between St. Patrick street and the Grande allée, and also along the north-western extremity of Parliament square, similar strata occur; dark brown or black compact bitumino-calcareous splintery shales weathering grayish-white, holding cavities in which Mr. Ferrier has recognized crystals of strontianite arranged in stellate groups and associated with terminated crystals of quartz ("diamonds") and an inspissated substance resembling petroleum. These strata dip at an angle of S. 65° E. (average magnetic), and hold fragments of graptolites, *Corynoides calycularis*, and also a *Discina* (undetermined). Measured sections of these exposures have been taken for reference, and serve to connect these beds with those occurring between the drill shed and the Grande allée.

Between Drill Shed and Grande Allée.—Here, as nearly everywhere in Quebec city, may be seen the upturned and denuded edges of the shaly and calcareo-argillaceous strata for a considerable distance. An artificial section at this point gives an average dip of 55°, S. 20° E. (magnetic), varying from 50° at the southern extremity to 58° or 60° as we proceed northward. The strata are somewhat disturbed at the southern end, but are very evenly bedded and contain quite an interesting series of fossils, chiefly graptolites throughout. The presence of iron pyrites in these rocks has stained many of the layers, which present a very rusty appearance. The following is a list of forms (provisionally identified) recognized from this section 45 paces in length:

<i>Diplograptus angustifolius</i> ;	<i>Climacograptus perexavatus</i> ;
" <i>foliaceus</i> (?);	" <i>confertus</i> (?);
" sp. und.;	<i>Dawsonia</i> , sp. und.;
<i>Dicellograptus sextans</i> (?);	<i>Primitia mundula</i> , Jones.

Similar strata were observed farther along the Citadel front, where the landslide took place in September, 1889, and along Champlain street by Saut-au-Matlot street, Sous-le-Cap street, Côte d'Ambourgés, and St. Charles street, where the dips observed showed clearly that round Cape Diamond the strata, as Sir William Logan noted,* form a synclinal basin at Quebec. Alongside and up Mountain street a bold cliff of conglomerate occurs, containing large boulders imbedded in a shaly and calcareo-argillaceous paste, with the admixture of quartz grains. This deposit, as well as most of the exposures in Quebec city, deserves very special attention and will no doubt afford interesting notes and material. The *Corynoides* band which occurs at the Cove field and near Montcalm market was again noticed along St. John street in excavations on the lot where numbers 71 and 73 of that street occur. *Dicellograptus sextans* was collected here. The strata dip at an angle of from 40° to 70° southward, increasing in intensity toward the northern end of the lot, close to St. John street.

Review.—So far the fossil remains, while numerous and many of them well-known "Hudson River" forms, are but little known and require detailed study.

Before assigning a definite position to the rocks of Quebec city in the scale of terranes in America, it is necessary for the writer to state that so far he has been unable to find any evidence in the field, either stratigraphical or paleontological, whereby the Hudson River rocks and Lorraine shales, as originally understood by Emmons, could be correlated and referred to the same or an immediately following geologic terrane.

The fossils collected at Côte d'Abraham have a decided lower Trenton facies, as the presence of *Solenopora compacta*, or a variety of this species, seems clearly to indicate. From the long list of species obtained in the Montcalm market rocks it can readily be seen that we have there represented a fauna which has never yet been found either in the Lorraine, Utica, or Trenton terranes—a fauna distinct from the faunas included in these three terranes, whose characters are so well known throughout the continent in their undisturbed and complete development. It is the same fauna which has received in numerous places the name "Hudson River," e. g., at Normanskill and many other localities in New York and Vermont, and in Canada, at False point, Island of Orleans, on the Etchemin river between St. Henry and St. Anselme, at Drummondville, on Crane island, Gagnon's beach, the Marsouin and Gros Mâle, a mile and a half below the Tartigo river, at Griffon cove, and in many other localities. Similar strata have also been observed in northern Maine, in Newfoundland and New Brunswick.

Now, the question presents itself: What is the age of these rocks and what the horizon to which the internal fossil evidence points at those localities where this fauna is found? A number of vexed questions arise. But, tak-

* Geology of Canada, 1863, p. 230.

ing into consideration the stratigraphical, lithological and paleontological relations and dicta of the rocks of this clearly distinct and well-marked terrane in the scale of geologic terranes in America, we can readily separate them from others, such as the Lorraine and Utica terranes, with which they have been for years made synchronous or newer. The fauna enclosed in the typical Lorraine shales, *i. e.*, in those shales which overlie the Utica shale and underlie the Oswego, or, as it is now called, Medina, sandstone, is well known and can be studied to advantage in Canada around the Manitoulin islands, at Collingwood, and at various points from that place to Oakville and southeastward by Weston and Toronto, in New York and in the valley of the Richelieu river, in the Ottawa Paleozoic basin and near St. Nicholas, at Côte Sauvageau, in the St. Charles river valley, at Montmorency below the falls, at Ste. Famille, and on the Island of Orleans at Ste. Anne de Beaupré, at St. Joachim, and also along the northern shore of Anticosti.

There seem to occur then two distinct faunas entombed in distinct series of strata and holding a different position as to age. The apparently lower Trenton aspect of a portion of the Quebec massif as seen at Côte d'Abraham and Côte de la Nègresse gives us an indication of the age of the strata at these points. Cut off on all sides by faults and separated from the Lévis rocks by the St. Lawrence river, the Quebec terrane (which name I beg to propose for this series of strata such as we meet at the Montcalm market, Parliament square, and drill-shed exposures) stands by itself in an anomalous position very similar to rocks of similar age which Professor Lapworth designated as "unplaced in the series."*

There is a marked physical resemblance between the Quebec massif and the Lévis rocks south of the city, but one series is a highly bitumino-calcareous terrane; the other not so. The presence of such forms as *Agnostus*, *Aeglina*, *Ampyx*, *Dionide*, *Bathyrurus*, etc., point to a rather lower horizon than the Trenton, while I believe that it is perhaps premature to give the precise geological position of the strata at Quebec, in the present light of our knowledge. Suffice it for this occasion to separate this terrane from that of the Lorraine shales or Lorraine terrane, *i. e.*, overlying the Utica, and recognize it as a distinct one, whose more exact position will form an interesting object of research. But a few days, comparatively speaking, have been spent in examining the strata at Quebec, and the limestone bands and shales interstratified are richly fossiliferous.

The Lévis.—Next in order comes the Lévis terrane, whose characters, both paleontological and stratigraphical, are given in detail in the reports of the Canadian survey and in many other interesting memoirs and publications. Along with Dr. Ells, the writer has made an examination of the fossiliferous

*This same authority had recognized the earlier age of the "Hudson River rocks" in America and their identity with the Glenkiln shales of south Scotland as their European equivalents.

strata occurring there. The lists of species and descriptions of the beds are given in the "Second report on the geology of a portion of the province of Quebec," which Mr. Walcott has recently reviewed in the American Journal of Science.

The probably Calciferous age of these strata, termed Lévis, has been proven by Mr. Billings on paleontological evidence. The abundance of graptolites and of certain well-marked zones of these in different portions of the series of Lévis strata, along with the recurrence of the conglomerate bands carefully mapped by Sir William Logan, enable the geologist to trace out the foldings and recurrence of strata at different points. The occurrence of large cephalopods in pebbles of the conglomerate, besides the Cambrian forms which many of these hold, is a point worthy of closer scrutiny.

The following is a list of species collected by Dr. Ellis, Mr. Giroux and the writer at Lévis, all obtained from definitely located places:

GRAPTOLITIDÆ.

<i>Nemagraptus capillaris</i> (?);	<i>Loganograptus logani</i> ;
" sp. und.;	<i>Clonograptus rigidus</i> ;
<i>Didymograptus bifidus</i> ;	" <i>flexilis</i> ;
" <i>constrictus</i> ;	" sp. und.;
" <i>extensus</i> ;	<i>Goniograptus thureaui</i>
" <i>furcillatus</i> ;	var. <i>schwyni</i> ;
" <i>pennatulus</i> ;	<i>Diplograptus dentatus</i> , Bgt.
" sp. und.;	(= <i>D. pristiniiformis</i> , H.);
<i>Tetragraptus approximatus</i> ;	<i>Diplograptus</i> (?) <i>tricornis</i> ;
" <i>caduceus</i> , Salter	<i>Phyllograptus anna</i> ;
(= <i>T. bigsbyi</i> , Hall);	" <i>angustifolius</i> ;
" <i>denticulatus</i> ;	" <i>typus</i> ;
" <i>fruticosus</i> ;	<i>Trigonograptus ensiformis</i> ;
" <i>headi</i> ;	<i>Ptilograptus plumosus</i> ;
" <i>hicksi</i> ;	<i>Dictyograptus irregularis</i> ;
" <i>quadribrachiatus</i> ;	" sp. nov.
" <i>serra</i>	(= <i>D. delicatula</i> , Dawson);
(= <i>T. bryonoides</i>);	" sp. (cf. <i>D. homfrayi</i>);
<i>Dichograptus octobrachiatus</i> ;	" sp. und.;
" <i>richardsoni</i> ;	
" <i>ramulus</i> ;	

BRACHIOPODA.

<i>Lingula quebecensis</i> ;	<i>Leptobolus</i> (?), sp. und.;
" <i>irene</i> ;	<i>Linnarssonina</i> , sp. und.;
" sp. nov.;	<i>Siphonotreta</i> (?) <i>micula</i> ;
" sp. und.;	<i>Orthis</i> , sp. und.;
<i>Elkania desiderata</i> ;	<i>Shumardia granulosa</i> .

These fossils were all derived from the shales and evenly bedded limestones of Lévis age. This number and list can no doubt be swelled considerably after careful collecting and determination. There are many species both of Cambrian and Cambro-Silurian (Ordovician) age included in the pebbles of the conglomerates of the Lévis terrane. These should be carefully collected and noted. Fossils from the paste of the conglomerate, if any, should be carefully kept separate, and interesting results will no doubt be forthcoming.

The Sillery.—Underlying the Lévis and faulted together at many points we find the Sillery, red, green and black shales associated with sandstones and conglomerates. The leading paleontological characters of this series so far is the presence of *Obolella* (*Linnarssonina*) *pretiosa*, Billings, in great abundance wherever that terrane is met with. At the Chaudière River railway bridge this shell occurs in great abundance, associated with other forms of *Obolella* and two species of *Lingula*; also with a *Protospongia*, akin to *P. tetranema*, Dawson. The presence of these spicules of sponges, referred to the genus *Protospongia* by the writer in 1883 along with *Obolella*, point clearly to the antiquity and earlier age of the Sillery than that to which it was for a long time assigned. A number of obscure compound graptolites and a species of *Phyllograptus* also occur at the Chaudière river exposures, indicating the probably transitional character of these passage beds between the Cambrian and Cambro-Silurian (Ordovician) epochs.

CONCLUSION.

Having thus briefly described the various terranes as they are seen along the line of section north and south, it will be observed on resuming the question of the probable age of the Quebec city massif that, when these are compared with the Lévis terrane, their physical character, the presence of the conglomerate bands, the similarity of strata in sedimentation and in their lithological characters, together with the general field aspects give them, owing to their intimate relations as having been subjected to similar pressures and foldings, the appearance of being a part and parcel of that greater series of sedimentary strata to which Sir William Logan advisedly gave the name "Quebec group." It would also appear that the Quebec terrane, while distinct from the Lévis terrane paleontologically, still exhibits numerous points in contact and would form an upward extension of that series at the base of which we find the Sillery. This would, I hold, materially assist in demonstrating the proper interpretation of the term "Quebec group" as Sir William Logan and Mr. Billings knew it, as regards the fossiliferous portion of that interesting series of sedimentary strata.

We should thus have the Quebec group divisible into three natural and well-marked parts:

3. The Quebec or upper division;
2. The Lévis or middle division;
1. The Sillery or lower division,

just as we find the Trenton group divisible also into series of terranes; and these divisions are all marked by peculiar and distinct faunas, each of which is characterized by fossils to be given in the table hereto appended.

The Trenton group characterizes the upper portion of the Cambro-Silurian or Ordovician system; the Quebec group characterizes a portion and peculiar development of the Cambro-Silurian or Ordovician.

DISTRIBUTION OF GENERA AND SPECIES.

GENERA AND SPECIES.	Terranes.				
	Lorraine.	Utica.	Trenton.	Quebec.	Lévis.
SPONGIÆ.					
<i>Hyalostelia</i> , sp.			x		
HYDROIDA.					
<i>Leptograptus flaccidus</i> , Hall		x			
" sp.				x	
<i>Nemagraptus capillaris</i> , Emmons					x
" sp.					x
<i>Didymograptus bifidus</i> , Hall					x
" <i>constrictus</i> , Hall					x
" <i>extensus</i> , Hall					x
" <i>fureillatus</i> , Lapworth					x
" <i>pennatulus</i> , Hall					x
" sp.					x
<i>Tetragraptus approximatus</i> , Nicholson					x
" <i>caduceus</i> , Salter (= <i>T. bigsbyi</i> , Hall)					x
" <i>denticulatus</i> , Hall					x
" <i>fruticosus</i> , Hall					x
" <i>headi</i> , Hall					x
" <i>hicksi</i> , Lapworth					x
" <i>quadribrachiatulus</i> , Hall					x
" <i>serra</i> , Brongniart (= <i>T. bryonoides</i> , Hall)					x
<i>Nichograptus octobrachiatus</i> , Hall					x
" <i>richardsoni</i> , Hall					x
" <i>ramulus</i> , Hall					x
" sp.					x
<i>Loganograptus logani</i> , Hall					x
<i>Clonograptus flexilis</i> , Hall					x
" <i>rigidus</i> , Hall					x
" sp.					x
<i>Goniograptus thureaui</i> , McCoy, var. <i>selwyni</i> , Ami					x
<i>Diplograptus dentatus</i> , Brongniart (= <i>D. pristini-formis</i> , Hall)					x
" sp. und.		x			
" <i>foliaceus</i> , Murchison				x	
" <i>angustifolius</i>				x	
" <i>rugosus</i> , Emmons				x	
" <i>mucronatus</i> , Hall				x	
" <i>whitfieldi</i> , Hall				x	
" <i>tricornis</i> , Carruthers					?
" sp. nov.	x				
<i>Dicellograptus anceps</i> , Hall				x	
" <i>moftatensis</i> , Carr., var. <i>divaricatus</i> , Hall					
" <i>forchhammeri</i> , L.				x	

Distribution of Genera and Species—Continued.

GENERA AND SPECIES.	Terranes.				
	Lorraine.	Utica.	Trenton.	Quebec.	Lévis.
<i>HYDROIDA</i> —Continued.					
<i>Dicellograptus sextans</i> , Hall				x	
" sp.				x	
" sp.				x	
<i>Dicranograptus ramosus</i> , Hall				x	
" cf. <i>D. nicholsoni</i> , Hopkinson				x	
" sp. nov.				x	
<i>Climacograptus bicornis</i> , Hall				x	
" <i>scalaris</i> , Hisinger, var. <i>normalis</i> , Lapworth				x	
" <i>scalaris</i> , Hs., var.				x	
" <i>scharenbergi</i> , Lapworth				x	
" <i>perezcavatus</i> , Lapworth				x	
" sp.				x	
" sp.				x	
<i>Orthograptus quadrimucronatus</i>	x	x			
<i>Phyllograptus angustifolius</i> , Hall	x	x			x
" <i>anna</i> , Hall					x
" <i>typus</i> , Hall					x
<i>Glossograptus ciliatus</i> , Emmons					?
" sp.				x	
<i>Reteograptus eucharis</i> , Hall	?				
<i>Cænograptus gracilis</i> , Hall				x	
<i>Trigonograptus ensiformis</i> , Hall					x
<i>Ptilograptus plumosus</i> , Hall					x
<i>Dictyograptus irregularis</i> , Hall					x
" sp. nov. (= <i>D. delicatula</i> , Dawson)					x
" cf. <i>D. homfrayi</i> , Lapworth					x
" n. sp.					x
<i>Dendrograptus</i> , sp.					x
" sp.				x	
<i>Corynoides calycularis</i> , Nicholson				x	
<i>Dawsonia</i> , sp.				x	
" sp.					x
<i>CRINOIDEÆ.</i>					
<i>Glyptocrinus decadalactylus</i> , Hall	?				
" sp.			x ?		
<i>Heterocrinus canadensis</i> , Bill.			x		
Crinoidal fragments				x	
<i>VERMES.</i>					
<i>Serpulites dissolutus</i> , Billings		x			
<i>BRYOZOA.</i>					
<i>Amplexopora discoidea</i> , James			x		
<i>Batostoma ottawäense</i> , Foord			x		

Distribution of Genera and Species—Continued.

GENERA AND SPECIES.	Terranes.				
	Lorraine.	Utica.	Trenton.	Quebec.	Lévis.
BRYOZOA—Continued.					
<i>Prasopora lycopodon</i> , Vanuxem	?		x		
" <i>lycopodon</i> , Van., var. <i>selwyni</i> , var. nov.			x		
<i>Monotrypa incerta</i> , sp. nov.		?			
<i>Diplotrypa quebecensis</i> , sp. nov.				?	
<i>Pachydietya acuta</i> , Hall			x		
<i>Ptilodictya falciiformis</i> , Nich.			x		
<i>Girvanella</i> , sp.			?		
<i>Solenopora compacta</i> , Billings			x		
" <i>compacta</i> , B., var. <i>minuta</i> , var. nov.					
BRACHIOPODA.					
<i>Lingula curta</i> , Hall		x			
" <i>obtusa</i> , Hall		x	x		
" <i>philomela</i> , Billings			x		
" <i>riciniiformis</i> , Hall			x		
" <i>quebecensis</i> , Billings					x
" <i>irene</i> , Billings					x
" sp. und.					x
" sp. nov.					x
" sp. nov. no. 1				x	
" " no. 2				x	
" " no. 3				x	
<i>Obolella</i> , sp.					x
" sp. nov.				x	
<i>Eikania desiderata</i> , Billings					x
<i>Linnarssonina</i> , sp.					x
<i>Leptobolus insignis</i> , Hall		x			
" sp.	x				
" sp. und.					x
<i>Paterula</i> (?), sp. nov.				x	
<i>Schizocrania filosa</i> , Hall		x			
<i>Siphonotreta micula</i> , McCoy					?
<i>Crania</i> , sp.			x		
<i>Discina</i> , sp.	x				
" <i>pelopea</i> , Billings			x		
" sp. nov. no. 1				x	
" sp. nov. no. 2				x	
<i>Skenidium</i> , sp.			?		
<i>Strophomena alternata</i> , Conrad			x		
" <i>deltoides</i> , Conrad	?				
" sp. nov.		x		x	
" sp.			x		
<i>Leptæna sericea</i> , Sowerby	x			?	
" sp. nov.				x	
" sp. allied to <i>L. quinquecostata</i>				x	
<i>Orthis emacerata</i> , Hall	x				
" <i>testudinaria</i> , Dalman	x		x		
" sp.	x				

Distribution of Genera and Species—Continued.

GENERA AND SPECIES.	Terranes.				
	Lorraine.	Utica.	Trenton.	Quebec.	Lévis.
BRACHIOPODA—Continued.					
<i>Orthis pectinella</i>			x		
" sp.		x			
" sp. nov.			x		
" sp. nov.				?	
" sp.					x
<i>Zygospira headi</i> , Billings	x				
<i>Anazyga recurvirostra</i> , Hall	x ?		x		
<i>Stricklandinia</i> (?), sp.				x	
<i>Anastrophia hemiplicata</i> , Hall			x		
" sp.		?			
LAMELLIBRANCHIATA.					
<i>Pterinea trentonensis</i> , Hall			x		
<i>Ambonychia radiata</i> , Hall	x				
" <i>bellistriata</i> , Hall			x		
<i>Modiolopsis</i> , sp.	x				
" sp.	x				
<i>Vanuxemia</i> , sp.			x		
<i>Ctenodonta dubia</i> , Billings			x		
<i>Lyrodesma pulchellum</i> , Emmons		x			
" sp.	x				
<i>Orthodesma parallelum</i> , Hall	x				
GLOSSAPHORA.					
<i>Murchisonia gracilis</i> , Hall			x		
" <i>perangulata</i> , Hall			x		
<i>Euomphalus</i> , or <i>Ophileta</i> , sp. nov.				x	
<i>Bellerophon bilobatus</i> , Sowerby	x	x	x		
<i>Bucania punctifrons</i> , Emmons			x		
<i>Conularia trentonensis</i> , Hall			x		
<i>Theca</i> , sp. nov.			x		
CEPHALOPODA.					
<i>Orthoceras laqueatum</i> (?), Hall			x		
" sp. nov.			x		
<i>Endoceras proteiforme</i> , Hall		x	x		
<i>Lituities undatus</i> , Emmons			x		
OSTRACODA.					
<i>Primitia mundula</i> , Jones				x	
" "			x		
" <i>logani</i>				x	
" " var.	?				
" <i>whiteavesii</i> , Jones			x		
<i>Aparchites mundulus</i> , Jones			x		
<i>Polycope</i> , sp.				x	
<i>Ischilina amii</i> , Jones			x		

Distribution of Genera and Species—Continued.

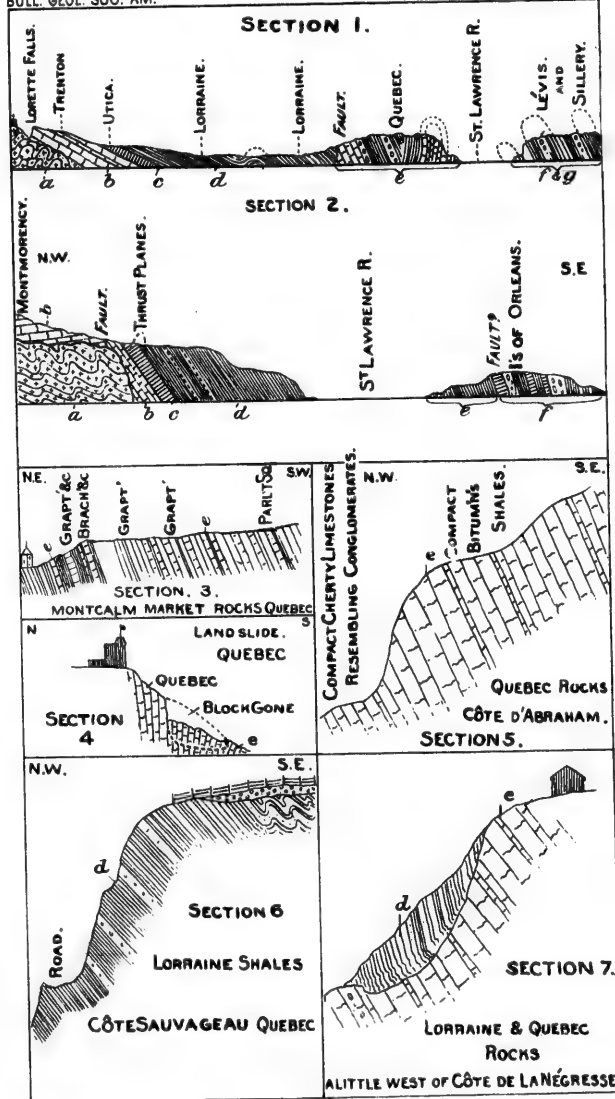
		Terranes.				
GENERA AND SPECIES.		Lorraine.	Utica.	Trenton.	Quebec.	Lévis.
<i>TRILOBITA.</i>						
	<i>Shumardia granulosa</i> , Billings				x	x
	<i>Aeglina rediviva</i> (?), Barr.				x	
	<i>Ampyz</i> , sp.				x	
	<i>Agnostus</i> , sp.			x		
	<i>Harpes</i> , sp.			x		
	<i>Trinucleus concentricus</i> , Eaton	x				
	" sp. nov.				?	
	" sp.				x	
	<i>Bathyurus</i> , sp.			x		
	<i>Calymene senaria</i> , Conrad			x		
	<i>Asaphus platycephalus</i> , Stokes		x			
	" <i>canadensis</i> , Chapin				?	
	" sp.			x		
	<i>Illænus mulleri</i> , Billings				x	
	" cf. <i>T. bouchardi</i> , Barr.				x	
	<i>Dionide</i> , cf. <i>D. lapworthi</i> , R. Etheridge, Jr.			x		
	<i>Dalmanites callicephalus</i> , Green			x		
	<i>Ceraurus pleurecanthemus</i> , Green			x		
	<i>Encrinurus vigilans</i> , Hall			x		

EXPLANATION OF PLATE 20.

- Section 1*—A sketch section across the strike from Lorette to Lévis in a southeasterly direction (see also Bull. Geol. Soc. Am., vol. 1, p. 464, map accompanying Dr. Ells' paper). It includes the following terranes in their geographical sequence, beginning toward the northwest: *a*. Laurentian or Archean; *b*. Trenton; *c*. Utica; *d*. Lorraine (Hudson River of most geologists); *e*. Quebec (new terrane, separate from others); *f*. Lévis; and *g*. Sillery. The last three, *e*, *f*, and *g*, form part and parcel of the fossiliferous Quebec group, while *b*, *c*, and *d* form the Trenton group, which are separated by a fault—the great Appalachian fault (the “Quebec fault” of Ells, or the St. Lawrence and Champlain fault, or a branch of it, of other geologists).
- Section 2*—Sketch section at Montmorency falls, across the measures east of the gorge and across the Island of Orleans. The notation is the same as in section 1. The Utica shales are much disturbed here, both in their contact with the Trenton below and with the Lorraine shales above. Below the horizontal Trenton, capping the Laurentian gneiss, there are found calcareous sandstones of Trenton age, which have been called Potsdam “quartzites.” A downthrow fault passes in front of the bluff over which the waters fall.
- Section 3*—Sketch section across the measures near Montcalm market, Quebec city, showing the high angle of dip and the shales with limestones interstratified.
- Section 4*—A general view of the strata flanking the Citadel hill at the landslide of 1889. The structure there exhibited is that of an inclined denuded anticline.
- Section 5*—Sketch section through the calcareo-bituminous rocks and compact shales, with conglomeratic cherty bands associated, at Côte d'Abraham, where the monticuliporidæ have been obtained.
- Section 6*—Sketch section showing the thin, fissile and soft earthy shales of the Lorraine terrane—newer than the Utica—inclined at a considerable angle along the road at Côte Sauvageau, west of Martelle tower no. 4.
- Section 7*—Sketch section exhibiting the dying out of the outcrop of Lorraine or newer shales on the edge or brow of the hill near Martelle tower no. 4, between Côte Sauvageau (section 6) and Côte de la Négresse, where a series of impure semi-crystalline, bituminous and fossiliferous limestone occurs. Côte de la Négresse is west of Côte d'Abraham. The contact between the two series is very much broken up, *i. e.*, between *d* and *e*.

Legend.

<i>a</i> = Laurentian or Archean;	
<i>b</i> = Trenton terrane	} Trenton group.
<i>c</i> = Utica terrane	
<i>d</i> = Lorraine terrane	
<i>e</i> = Quebec terrane	} Quebec group.
<i>f</i> = Lévis terrane	
<i>g</i> = Sillery terrane	



SKETCH SECTIONS IN THE VICINITY OF QUEBEC CITY, CANADA.

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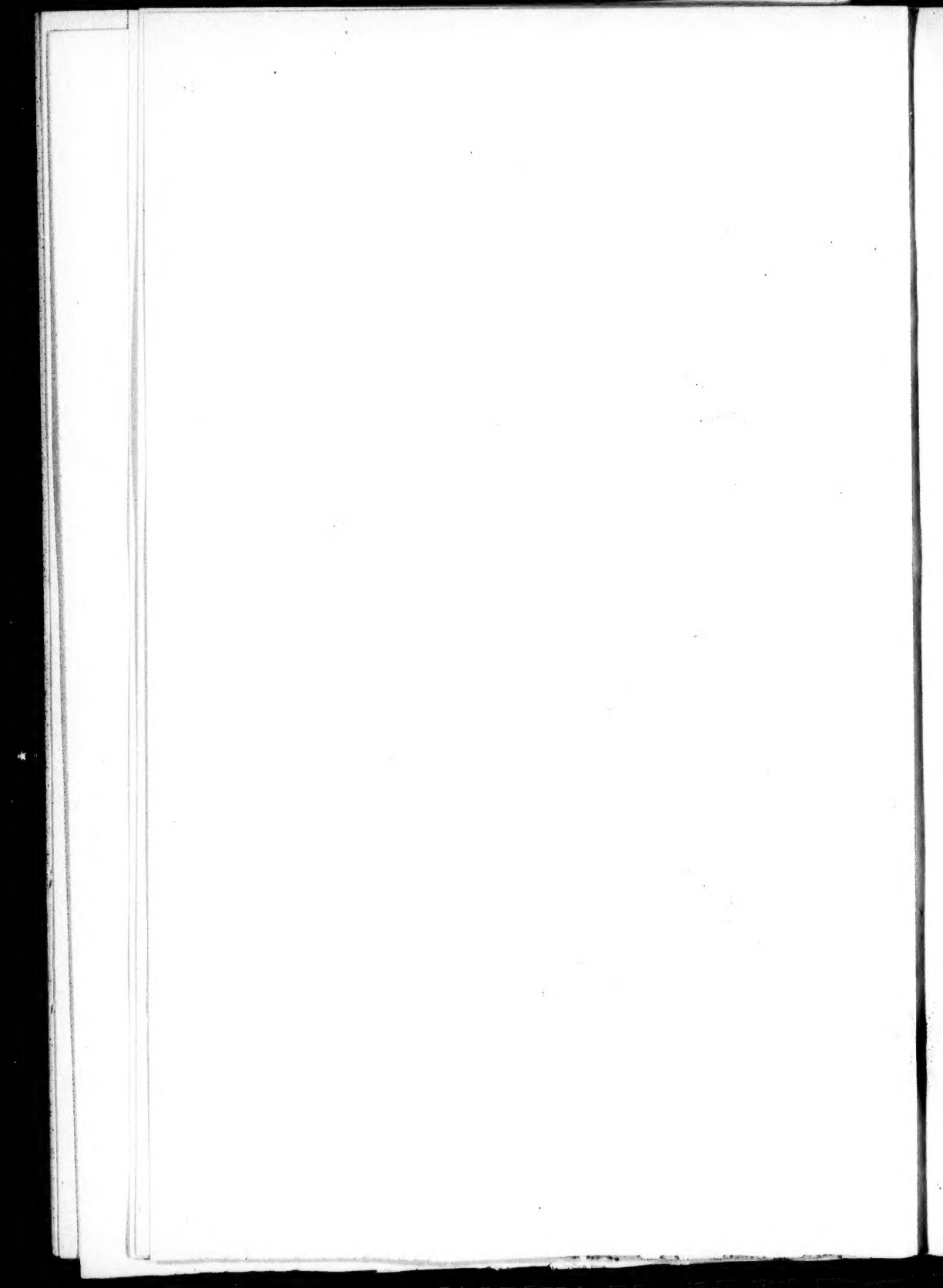
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DISCUSSION.

Dr. ALFRED R. C. SELWYN:* Sir William Logan alone assigned the rocks of the city of Quebec to the Lévis division of his Quebec group;† Selwyn alone assigned the rocks of the city of Quebec to the Hudson-Utica horizon, or above the Trenton, and pronounced them, before any fossils had been found in them, to be the same as those on the northern shore of the Island of Orleans, which had been assigned by Logan to Hudson-Utica. Fossils since found in the city of Quebec have proved the correctness, so far, of Selwyn's view. Whether Logan and Selwyn are right in placing these rocks above the Trenton is thus the only question now at issue.

Do the fossils determined by Mr. Ami conclusively prove his contention, that they are not above but below? In this connection, see "Geology of Canada," 1863, pages 199 to 204, for list of fossils and description.

Mr. C. D. WALCOTT: Sir William Logan, in his original definition of the Quebec group, divided it into two parts in the vicinity of Quebec. The Point Lévis series consists of the graptolite-bearing shales of Point Lévis, with their enclosed conglomerates, in which upper Cambrian or Potsdam fossils were found, as he supposed, in association with fossils of the age of the Calciferous formation of New York. Although no fossils were found in the rocks of Quebec city proper they were correlated with the Lévis series. Mr. Ami has now found a fauna in the Quebec city rocks which is distinct from that of Point Lévis, and I think that there should be two names, one for the rocks of Calciferous age at Point Lévis, and another for the Quebec rocks. I think the name Quebec should be restricted to the Quebec city rocks, which carry a distinct fauna from the strata at Point Lévis, and that the name Lévis should be applied to the graptolitic shales and the limestones in which the Calciferous fauna occurs. If Mr. Ami's determination of the fauna is correct, the horizon of the Quebec city rocks is that of the Trenton, probably the lower Trenton, and perhaps the upper portion of the Chazy of the New York section. As the rocks at Quebec are of a peculiar physical development and contain a peculiar fauna, I would suggest, if acceptable to the Canadian geologists, that the name Quebec be restricted to that series of rocks, and that the Point Lévis rocks be arranged under the name Lévis.

For the series of strata that have been formerly included under Quebec as about the Calciferous-Chazy horizon, as originally defined by Logan, which includes the Point Lévis series, the Quebec city series, the Phillipsburg

*In a note communicated to the Society.

†"Geology of Canada," 1863, p. 201.

limestone series, it might be possible, in the absence of any other name, to call it the Eolian, from an historical point of view. There are strong objections, however, to this name, and I do not wish this to be considered as a proposal for its use. Collectively the Quebec, Lévis, Phillipsburgh, Calceiferous, Chazy and other formations, occurring between strata of the Potsdam and Trenton terranes, can well be assembled under the term "Canadian" as proposed by Professor J. D. Dana.

Dr. EZRA BRAINERD: I should object to the term Eolian, since it is not a geographic term, but simply a fanciful name; and I do not consider it applicable to the series of rocks mentioned by Mr. Walcott.

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